The spider's web

Muscle bound

Type 'muscle' into your search engine, and you're likely to end up someplace like www.hugebiceps.com. But if what you really want is to understand the mysteries of myosin, a better place to start is the University of California, San Diego's Introduction to Muscle Physiology and Design site. Its general overview, written at a fairly basic level, starts with development and progresses through to biomechanical strength. There are separate pages on other muscle physiology topics, such as fiber types, intrinsic properties of muscle and muscle–joint interactions.

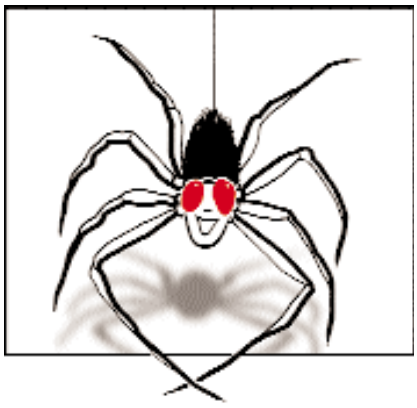
For anyone who stumbles in from www.hugebiceps.com, the UCSD site gives a nod to bodybuilding with sections on creatine, anabolic steroids and the quaint practice of simply exercising to build muscle. Interestingly, the initial increase in strength has more to do with nerve than with building muscle. In the first few days of exercise, there's an increase in the neural drive stimulating muscle contraction, so a 98-pound weakling can show measurable strength gains from just 'learning' to use the muscle. Eventually, muscle cells get the message that they're being asked to do more, so they switch on their protein-making machinery and new protein is added to the existing muscle cells.

For a look at those bulked-up muscles at work, visit the University of Michigan's site, Hypermuscle: Muscles in Action. This interactive site is designed to help students learn the muscle actions of the human body. Each type of muscle action — flexion/extension, abduction/adduction, pronation/supination, and so on — is briefly described in text, and a Quicktime video shows a real person demonstrating the action.

To zero-in on specific muscles, the Hosford Muscle Tables should be the next stop. A feature of PTCentral, an online source of physical therapy information and services, this site has a listing of the skeletal muscles of the human body, from abductor digiti minimi to zygomaticus minor. For each entry, the muscle's origin, insertion, action, blood supply and innervation are given. The muscle tables can be searched by individual muscle or by body region, using either a list or a clickable outline of the human body. After arriving at a particular body region, the user can explore its muscles in more detail or can click to related web links.

A completely different kind of muscle-building is the focus of the Artificial Muscle Project at the Massachusetts Institute of Technology Artificial Intelligence Laboratory. Using polymer hydrogel, researchers are developing artificial muscle that acts something like human muscle, undergoing reversible length changes in response to chemical stimuli. The ultimate goal is to use this artificial muscle in advanced robotic systems, not to replace or supplement human brawn.

The site of the Muscular Dystrophy Association has plenty of



meaty material. As the world's largest non-governmental sponsor of research on neuromuscular diseases, MDA funds research into 40 different diseases, including nine types of muscular dystrophy. For each disease, there's information on its characteristics, age of onset, progression and inheritance, and there are links to fact sheets, articles, news releases, profiles of people with the disease and other related resources. A Research Digest section summarizes current scientific papers related to MDA's programs and there's also a section on clinical trials.

The site's Recent Research Developments section has brief, clearly written summaries of important advances by MDA-funded researchers. The 1999 entries describe, for example, plans for the first human gene therapy trial for a muscle disease.

For serious muscle men and women, The MUSCLE Home Page at Brandeis University lists meetings, jobs and contact details for researchers in the field. Reedy's Muscle Database contains more than 11,000 downloadable references on motor proteins and muscle structure and function.

Clearly, the online resources offer more than advice on bulking up at Muscle Beach. Pointing, clicking and muscling your way around the web can take you from muscle design to disease and beyond.

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This month's URLs

Introduction to Muscle Physiology and Design	http://ortho84-13.ucsd.edu/MusIntro/
Hypermuscle: Muscles in Action	http://www.med.umich.edu/lrc/Hypermuscle/Hyper.html
Hosford Muscle Tables	http://www.ptcentral.com/muscles/
Artificial Muscle Project	http://www.ai.mit.edu/projects/muscle/overview.html
Muscular Dystrophy Association	http://mdausa.org/
The MUSCLE Home Page	http://www.rose.brandeis.edu/users/muscle/
Reedy's Muscle Database	http://note.cellbio.duke.edu/Faculty/~Reedy/Muscle/MuscleDB.html